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(d) consolidating said deposit of amorphous particles into a non-porous transparent glass body; and

(e) drawing waveguide fiber from said body; the improvement comprising utilizing as said silicon-containing compound in vapor form a halide-free polymethylcyclsiloxane, whereby no halide-containing vapors from said silicon-containing compound are emitted during the making of said optical waveguide fibers. why =

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### REMARKS

In view of the above amendments and the following remarks, applicants respectfully request reconsideration.

Of the patent claims, claims 1, 4-7, 10-13, 16-17, 20-23, and 26 are pending, while claims 2-3, 8-9, 14-15, 18-19, and 24-25 are canceled. Added claims 27 and 30 are pending. The status of the pending claims is that claims 13 and 16 are allowed, claims 1, 4-7, 10-11, 17, 20-21, 23, 26-27, and 30 are pending, and claims 12 and 22 are objected to.

By the above amendments, claims 12 and 22 are being put in independent form. Support for these amendments is found in patent claims 7 and 12 and claims 17 and 22, respectively.

The rejection of claims 1, 4-6, 23, and 27-32 under 35 U.S.C. § 103 for obviousness over Japanese Kokai Patent Application No. 138145 to Kawaguchi et. al. ("Kawaguchi") in view of European Patent No. 38,900 to Schwarz et. al. ("Schwarz") is respectfully traversed.

Kawaguchi relates to a method of making a quartz glass element by synthesizing silica particles from a silane compound or a siloxane compound (e.g., hexamethyldisiloxane) and depositing the particles on a rotating carrier at a thickness of 1-300  $\mu\text{m}$ . After deposition, the particles on the carrier are vitrified to form a glass. There is no disclosure of preparing glass from a polymethylcyclsiloxane.

Schwarz manufactures a silicic acid dispersion having a specific BET surface of  $250 \pm 25$  to  $350 \pm 25$   $\text{m}^2/\text{g}$  and a thickening viscosity of 4000 to 8000 mPas in unsaturated polyesters by burning a siloxane or mixture of siloxanes in the presence of hydrogen or a hydrocarbon. Suitable siloxanes include hexamethylcyclotrisiloxane or octamethylcyclotetrasiloxane.

In the Amendment under 37 CFR § 1.116, filed July 9, 1999, applicants argued that Schwarz was directed to making silicic acid which is chemically different from the quartz glass made by Kawaguchi. Accordingly, it was urged that Schwarz and Kawaguchi could not be properly combined. Upon further investigation, however, applicants have ascertained that although Schwarz is producing silicic acid, it is also in all likelihood producing silica -- i.e. silicon dioxide. Applicants regret any confusion created by its prior argument, but maintain, nevertheless, that Schwarz and Kawaguchi are not properly combinable.

The silicic acid dispersion of Schwarz is never built up on a carrier as a deposit and consolidated. It, instead, is produced in a dispersed form and used in this state to thicken a variety of products. There is no suggestion in Schwarz that the resulting silicic acid dispersion is suitable for build up as a deposit on a support. There is also no indication that such a deposit can be consolidated to form a consolidated glass body. Indeed, using the procedure of Schwarz in this manner would be contrary to the teachings of this reference which seeks to make a high surface area dispersion that never builds up as a deposit and does not undergo consolidation. There is no expectation that the technique of Schwarz, which processes a polycyclosiloxane to form silicic acid dispersion, would be useful in conjunction with a process for making a consolidated glass monolith. Since this is, in fact, what Kawaguchi is making, one of ordinary skill in the art would have no reason to combine Schwarz and Kawaguchi.

At the time that the present invention was made, researchers in the art would not have expected the polycyclosiloxanes of Schwarz to be useful in producing a non-porous body of high purity fused silica glass (See attached Declaration of Michael S. Dobbins Under 37 CFR § 1.132 ("Dobbins Declaration") ¶ 5). In particular, Schwarz's polycyclosiloxanes have a large number of carbon atoms and not all of these carbon atoms would have been expected to combust when passed through a burner (*Id.*). Indeed, the production of carbon when burning polycyclosiloxanes to form pyrogenic or fume silica or silicic acid is well documented in the literature (*Id.*). GB 2,049,641 to Kratel et. al., (page 1, lines 6 to 28) states the following:

Very finely divided silica (highly disperse silica)  
may be manufactured by flame hydrolysis, which

comprises reacting a gaseous or vaporisable silicon compound and, optionally, another gas that will burn to form water, with oxygen in a flame (see, for example, DE 900 339, U.S. 2,399,687, G.B. 17325/77 Serial No. 1562966 (equivalent to DE 26 20 737 A1)). Silica manufactured in this manner is known as pyrogenic silica or fume silica. Satisfactory results can be obtained by this method when silicon tetrachloride is used as the gaseous silicon compound. It is, however, often advantageous to use an organosilane as the gaseous silicon compound, but the silica produced from these compounds tends to be contaminated with carbon and thus tends to be dark in colour. This result when using silicon compounds containing silicon-bonded organic groups, especially halogen-containing silicon compounds, has previously been counteracted by using an additional fuel, namely an additional gas that will burn to form water, for example hydrogen or hydrocarbon.

(Id.). In addition, J. Lipowitz, "Flammability of Poly(Dimethylsiloxanes). 1. A Model for Combustion," J. Fire & Flammability 7: 482-503 (1976) states:

Under fuel-rich conditions ( $\phi > 1$ ), two-stage combustion is evident by formation of inner and outer flame cones. The outer flame cone is a pale bluish color typical of the outer cone of organic flames, both representing further combustion of CO and H<sub>2</sub>. However, the inner cone is blue at  $\phi < 2.67$  and luminous yellow-white at  $\phi > 2.67$ . Organic flames are luminous yellow due to blackbody radiation from carbon particles. Significantly, adiabatic calculations show carbon formation from D<sub>4</sub> and MM at  $\phi > 2.67$ .

\* \* \*

Gray-brown amorphous silica collected above diffusion flames, which are luminous (yellow-white), contains 3-4% total C, primarily elemental carbon, and 0.1-0.2% H. A weak infrared band indicating some C-H bond structure is present at 2925 cm<sup>-1</sup>. No crystallinity indicative of SiO<sub>2(g)</sub>, graphite, SiC, or Si<sub>3</sub>N<sub>4</sub> is found by x-ray powder diffraction or electron diffraction. Detectability limits are estimated at several %. Particulates consist of 100Å

diameter particles tightly aggregated into 700-1000Å clumps which are further agglomerated in chains (Figure 5). Some larger particles (2000-4000Å diameter) appear to be carbon and should contribute appreciably to the observed luminosity.

(Id.).

When, in accordance with the teachings of Schwarz, the dispersion product is used as a thickener, the existence of carbon in the dispersion would not present any difficulties (Dobbins Declaration ¶ 6). In fact, the presence of carbon would most likely have improved thickening (Id.).

However, the presence of carbon impurities could result in significant problems when making a non-porous body of high purity fused silica glass, particularly where that glass is used to make precision optical products like optical waveguide fibers (Dobbins Declaration ¶ 7). In making a non-porous body of high purity fused silica glass, scientists skilled in this area would not want any carbon to be present, not even at a parts per million level (Id.). Their concern at the time inventor Michael S. Dobbins made his invention would have been that production of carbon during glass formation could adversely affect light transmission in a number of ways (Id.). In particular, the presence of carbon particles in the glass would absorb light and cause light scattering resulting in transmission losses (Id.). Moreover, carbon particles in the glass would also be likely to associate with adjacent oxygen atoms that otherwise form silicon dioxide, resulting in C-O bond formation within the glass (Id.). Such C-O bonds would absorb light in the infrared region of the spectrum and cause transmission losses which prevent the light from traveling as far (Id.). This is a particularly significant problem in optical fibers where transmission is in the infrared region of the spectrum and such light must travel long distances (Id.). Carbon formation would also have been expected to physically remove oxygen (otherwise in the form of silicon dioxide within the glass) away from the glass as carbon monoxide (Id.). This would result in an electron deficiency in the resulting glass that would cause transmission loss in the ultraviolet region of the spectrum (Id.). Thus, the formation of carbon in a non-porous body of high purity fused silica glass, such as that used in optical fibers or precision lenses, would be highly undesirable (Id.).

By contrast, all of the claims of the present application call for the production of a non-porous high purity fused silica glass, while claims 13, 16, 17, and 20-22 set forth methods of making optical waveguide fibers. In view of the recognition in the art that passing polycyclosiloxanes through the flame of a burner would have been expected to produce carbon, scientists making a non-porous body of high purity fused silica glass would not have wanted to make such products by burning polycyclosiloxanes (Id.). In rejecting the claims over the combination of Schwarz and Kawaguchi, it is exactly this use of Schwarz's polycyclosiloxanes which is proposed. Therefore, this rejection is improper and should be withdrawn.

To the extent the U.S. Patent and Trademark Office ("PTO") is merely relying upon Schwarz to teach that the claimed siloxanes are known, the rejection is completely improper.

A proper *prima facie* showing of obviousness requires the PTO to satisfy three requirements. First, the prior art relied upon, coupled with knowledge generally available to one of ordinary skill in the art, must contain some suggestion which would have motivated the skilled artisan to combine references. See In re Fine, 837 F.2d 1071, 1074, 5 USPQ2d 1596, 1598 (Fed. Cir. 1988). Second, the PTO must show that, at the time the invention was made, the proposed modification had a reasonable expectation of success. See Amgen v. Chugai Pharm. Co., 927 F.2d 1200, 1209, 18 USPQ2d 1016, 1023 (Fed. Cir. 1991). Finally, the combination of references must teach or suggest each and every limitation of the claimed invention. See In re Wilson, 424 F.2d 1382, 1385, 165 USPQ 494, 496 (CCPA 1970).

Applicants do not dispute that the claimed siloxanes were known at the time the present invention was made. However, this is not the issue. The question is whether it would have been obvious at that time to utilize such cyclic siloxanes to make non-porous silicon dioxide glass by forming SiO<sub>2</sub> particles, depositing the particles on a support, and consolidating the deposited particles into a non-porous glass body, as claimed. If Schwarz is simply cited as teaching that polycyclosiloxanes were known, then there is no suggestion to use polycyclosiloxanes in the claimed process, let alone any expectation that such materials could be successfully used to produce a non-porous, high purity fused silica glass. Indeed, as noted *supra*, the expectation was that this polycyclosiloxane could not have been successfully used to make a non-porous, high purity fused silica glass. In view of these deficiencies in

Schwarz and Kawaguchi, one of ordinary skill in the art would have had no basis to combine these references.

Further, applicants completely disagree with the following statement in the July 15, 1999, advisory action:

The combination suggested by Applicant was not used by the Office. Schwarz supplies all motivation for using any known siloxane.

Clearly, the final rejection of claims 1, 4-6, 23, and 27-32 is based on a combination of Kawaguchi and Schwarz. As noted above, Schwarz fails to teach numerous aspects of the present invention, including producing silicon dioxide particles, depositing the particles on a support, and consolidating the deposited particles into a non-porous high purity fused silica glass. Thus, Schwarz alone cannot be used to reject the claimed invention.

Even if, assuming *arguendo*, the combination of Schwarz and Kawaguchi could be properly used to reject the claimed invention, which it cannot, any *prima facie* case of obviousness would be rebutted by the evidence of unexpected results achieved by the present invention. See In re De Blauwe, 736 F.2d 699, 222 USPQ 191 (Fed. Cir. 1984). In particular, as shown in Example 4 and Figure 4 of the present application, the use of octamethylcyclotetrasiloxane has substantially improved deposition efficiency over  $\text{SiCl}_4$ . This is highly unexpected, particularly when one considers that Schwarz, in using such polycyclosiloxanes, does not suggest that the combustion product of this starting material can even form a deposit on a carrier, let alone deposit with greater efficiency.

Accordingly, the rejection over the combination of Schwarz and Kawaguchi should be withdrawn.

For all the foregoing reasons, the rejection over the combination of Schwarz and Kawaguchi should be withdrawn.

The rejection of claims 7, 9-10, 17, and 19-20 under 35 U.S.C. § 103 for obviousness over U.S. Patent No. 3,823,995 to Carpenter ("Carpenter") in view of Kawaguchi and Schwarz is not proper and should be withdrawn.

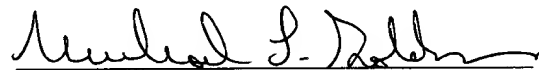
Carpenter is directed to a method for making optical waveguides with silicon tetrachloride.

Kawaguchi and Schwarz are not combinable for the reasons noted above. Carpenter does not overcome this deficiency, because it, like Kawaguchi, makes silicon dioxide articles but without using polymethylcyclsiloxanes. Thus, Carpenter is no more combinable with Schwarz than Kawaguchi. Since the art makes no suggestion of using a polymethylcyclsiloxane for anything other than particulate pyrogenic silicic acid, there would (for the reasons noted above) have been no motivation to combine Kawaguchi or Carpenter with Schwarz, nor any expectation that if such a combination were made (and a polymethylcyclsiloxane starting material were used) a useful product would result. Since the art fails to teach that such polycyclsiloxanes are useful in making non-porous, high purity fused silica glass by soot deposition and consolidation, the rejection of the claims based on the combination Carpenter, Kawaguchi, and Schwarz should be withdrawn.

In view of all the foregoing, it is submitted that this case is in condition for allowance and such allowance is earnestly solicited.

Respectfully submitted,

Date: November 23, 1999

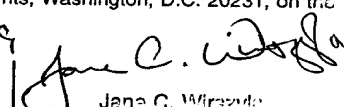


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11/23/99   
Date Jane C. Wilensky